HR0011SB20254XL-01
ALIAS Missionized Autonomy for Emergency Services - SBIR XL
Frequently Asked Questions (FAQs)

1. Does ALIAS anticipate integration with existing wildfire/emergency management platforms, or a stand-alone autonomy solution?
   A: ALIAS is the standalone autonomy solution/platform but will be integrating all novel/new/existing wildfire/emergency response management tools and software. It should be clear that the autonomy solution is for flight and the SDK is the gateway to utilizing/building apps on top of the autonomy platform for bespoke firefighting and teaming behaviors.

2. What level of autonomy is envisioned—limited to tactical execution, or also predictive planning and resource allocation?
   A: Predictive planning is currently being utilized to fly the aircraft. No embedded algorithms/AI or otherwise will not be allowed to be embedded in the autonomy stack. Software containers will be used to house the applications to drive the autonomy, the core autonomy stack will remain the same. This does not mean we can't utilize AI/ML to operate on top of the autonomy stack to drive specific novel behaviors.

3. Are evaluation metrics focused primarily on operational performance (e.g., navigation, response time), or also on resilience and resource optimization?
   A: All of the above. We are using autonomy to optimize both physical parameters within the aircraft and to optimize emergency response, think of the metrics as looking to evaluate whether certain applications or behaviors are a force multiplier.

4. Are firms able to access the ALIAS/MATRIX autonomy stack/systems before submission to ensure integration capabilities and alignment in their proposal?
   A: To access the ALIAS/MATRIX Software Development Kit (SDK), a company would need to have a contract and/or NDA with DARPA and/or Sikorsky. Thus, it is highly unlikely companies will be able to access the SDK prior to submission.

5. What are your expectations regarding the user interface for proposed plugins?
   A: Interface designs expectations are that they are to be designed to be usable in a high stress environment by non-technical personnel.

6. Are vendors expected to develop AFSIM models, or will these be provided for autonomy algorithm testing?
   a. If model development is required, will EO/IR, ELINT, and RF system specifications be provided to ensure accuracy?
   A: No, performers will not be expected to develop AFSIM models, models relevant to the developed application will be integrated with the SIL for HIL testing. EO/IR, ELINT, and RF system spec will be provided.

7. Will environmental and situational awareness data be provided to the autonomy application, or should it be derived by the application itself?
   A: In terms of A/C control Environmental and SA data will be provided by the vehicle management system and data messages will be available from the various sensors on board the aircraft. The applications can choose to interpret the data and use it as desired or infer relevant system states.

8. Could you clarify the term "contested" for this project?
   A: Area/Airspace control is not guaranteed.

9. Should the autonomy applications account for terrain in low-altitude flight planning?
   A: No, this is feature of the autonomy system. The applications will not be developing this feature, but you should be able to use that mode of flight for development needs and use cases.

10. In future multi-aircraft scenarios, will the system operate alongside fixed-wing or non-rotary assets?
    A: Yes.

11. Will the autonomy applications receive real-time wind data, or will this be estimated locally by each platform?
    A: Each platform will be receiving real time wind data locally and passing it to our proposed C2 architecture.

12. Is the development of a human machine interface (HMI) for the autonomy applications a component of this proposal? If an HMI does already exist in the ecosystem,
    a. Will the autonomy applications be expected to interface with it directly?
    A: An HMI is/isn't a component of the proposal depending on the proposed app functionality. An HMI to interface with the A/C does already exist and the app will be expected to pass data on the back end. However, front-facing HMI apps have been developed utilizing the SDK with the ability to pass information on a tablet. The implementation is up to the proposer if their app would function better with a standalone HMI.

    b. Is this application a TAK plug-in?
    A: We have plan to integrate with TAK, but it is not a requirement currently.

13. Is there access to a specification of the MATRIX SDK so that we can determine whether our technology is at the right level of abstraction?
    A: Unfortunately, proposers cannot access the MATRIX SDK, if selected technology, integration will be supported at no cost to the proposer. The SDK is fully MOSA compliant and can be readily integrated.

14. The scenario examples cover a broad range of abstraction, from relatively low-level control of a payload in challenging conditions to relatively high-level planning for

multiple vehicles. Should solutions cover the whole range of abstraction or are solutions that focus on one area of abstraction of interest?
A: Solutions that cover multiple areas and solutions that focus on a single area are of interest.

15. Should solutions consider how humans interact with the autonomy?
A: Solutions should consider how humans react to the autonomy in a high stress environment if it is of relevance to the proposers solution.

16. The effort requires live flight tests with the ALIAS platform, which can only be provided by Sikorsky. Is it expected that the SBIR funding will be used to support the ALIAS platform for these live flight tests, or should we treat the ALIAS platform as an available resource at no additional cost. Do these live flight tests need to fit a specific cadence, or do they need to occur at specific locations to accommodate the ALIAS platform availability?
A: The ALIAS platform will be treated as an available resource at no cost to the proposer. The proposer will be aware of the live flight test cadence of the ALIAS platform/s. The proposer will be able to test the functionality of their "app" through SDK/SIL prior to live demo. The proposer will need to accommodate travel given platform location, SBIR funding will support travel.

17. Though not mentioned in this announcement for integration into MATRIX and ALIAS, can the solution include the use of TAK (Team Awareness Kit)? It is kit already in use by firefighters on the front lines.
A: Yes, the solution can utilize TAK based architecture.

18. Capstone scenarios & MOEs/MOPs: Of the cited examples (fixed-burn suppression, rooftop personnel recovery, coordinated wildfire suppression, cargo sling, recon, crew shuttle), which are mandatory for Phase II, and what measures of effectiveness (e.g., drop accuracy / coverage, sortie time, mission throughput, safety events) and acceptance thresholds apply to each?
A: MOPs will be cemented upon final review of program test plan. At the current time we are trying to find and evaluate possible contributors to the test bed based upon what they can offer now that will be used to supplement test plan.
MOE creation will be a part of a beginning notional "exploration" phase as this is all new territory.
The TTPs we develop will be based on how the MOEs evolve during this period, thus acceptance criteria are not applicable until we have identified preliminary needs and gaps of using large autonomous vehicles for the mission. At the end of the notional exploration phase, MOEs should be clear for a future operational phase to then use and increase effectiveness through additional operational test and sprint development cycles. Exploration phase will encompass a set of key objectives plus any objectives we find necessary during this activity.

19. Ops constraints: What airspace classes, deconfliction rules, and civil/military coordination constraints should be represented in sim and flight? Are night/IMC or degraded-visibility operations in scope?
A: Any class airspace is fair play. Rules of the road should be incorporated in application design. Night ops/IMC operations are in scope.

Airspace class will be dependent on activity: for firefighting mission it will be TFRs, for SAR missions it will be in all airspace below FL180, etc. If we decide to move into A airspace this will be with coordination with FAA and most likely result in experimentation utilizing a dedicated TFR or within a Restricted zone. Sim should encompass these flight area rules and regulations as applicable. Due to likely future autonomous flight operations in national airspace, FAA deconfliction rules will need to be part of the applications and sim environment constraints. With that being said, our autonomy software has the capability to do this, but we will need performers that can build upon this stack to holistically incorporate these restrictions, such as automated deconfliction with dynamic separation distances tunable to meet mission criticality and risk tolerance for scenario.

20. Human roles: What level of human supervision is required (on-the-loop vs. in-the-loop) during autonomous execution? Define handover points, authority, and abort criteria.
    A: Novel designs with human-on-the-loop or out-of-the-loop supervision are desired. Reference autonomy stack design vision for more.
    Human involvement will be inexplicably tied to the operations both on-the-loop, and in-the-loop. The level of supervised autonomy needed for individual mission scenarios will be an objective of investigation during exploration. The level of human involvement will be inherent in the test plan.

21. SDK scope & ICDs: Please provide the ALIAS/MATRIX SDK version, Government Purpose Rights scope, API/ICD docs, message sets, timing constraints, and any required middleware (e.g., ROS 2/C++ bindings, container expectations).
    A: SDK and ICDs will be provided upon any award given after evaluation of proposals. Expect the SDK to be GFE for effort. Albeit, how support for SDK to proposers will be delivered has not been finalized, thus any proposal that does or does not account for SDK support will not be negatively impacted. If the evaluation of proposal meets technical needs, we will have follow-up discussion on how support will be administered.

22. Hosting model: Should the mission app run in-vehicle on the S-76/UH-60 avionics or as a separate mission compute node? Provide SWaP-C envelopes, OS constraints, and cyber hardening requirements.
    A: Mission apps will be a part of the autonomy stack located in a separate compute box on aircraft that is on-the-loop of the flight control computer.

23. Safety & authority partitioning: What functions must remain in the certified ALIAS/MATRIX core vs. what can be implemented in our third-party app (e.g., guidance vs. mission logic vs. sensing)?
24. **A: All safety of flight functions will remain within the ALIAS/MATRIX stack. The core will not be modified, and all applications will reside on top of it. All of the above can be implemented as a third party application on top of the core (GNC, mission logic, sensing, etc.).**
25. AFSIM fidelity: Confirm the required terrain/wind/vegetation/fire dynamics fidelity, sensor simulators (EO/IR/ISR feeds), and real-time performance targets. Are conformant sensor interfaces and time-sync specs defined?
    A: Dynamics and sensor simulators will be as needed, of sufficient fidelity, and produced by the test bed. Initial sensing capaiblity will be from LIDAR, EO/IR, etc. Other vehicle sensors such as air data sensors, radaltimeter, wind and humidity, will also be developed and utilized as necessary.
26. Data packages: What wildfire ground truth datasets, wind models, fuel maps, and historical fire perimeters will be Government-furnished? Any restrictions on 3rd-party data ingestion?

A: Any third-party data not provided by the government team will need to be provided as part of the proposal for funding requirements. Common, open-source weather models such as GFS and ECMWF will be utilized as part of the application development process.

27. Scenario generation & repeatability: What seed/control files and Verification, Validation, and Accreditation (VV&A) artifacts are required for scenario repeatability, regression, and government evaluation?
    A: Any files and artifacts necessary for test and evaluation are still being determined. Offeror should propose desired scenario generation and repeatability artifacts as a part of the initial proposal.
28. Sensor suite assumptions: For live demonstration, what sensors (EO/IR, LIDAR, radar altimeter, air data) are available on S-76/UH-60 and exposed through the SDK? Any restrictions on adding podded sensors?
    A: Any/all traditional sensing equipment and operations available off-the-rack or published on the UH-60 are of interest to the application development team. Any sensor that is available for testing will be exposed through the SDK. Offerors should include scope for podded sensor integration in their proposal, in the event that currently integrated sensors are insufficient to support proposed capability.
29. Perception KPIs: Define required performance for search/localize/track/assess (Pd/Pfa, update rate, geolocation error, latency) and the test methodology in sim and flight.
    A: This information will be made available with the SDK, on award.
30. Drop planning/logistics: For water/retardant drops and sling loads, what accuracy and stability metrics (e.g., bucket trajectory control, landing zone approach profiles) must be met?
    A: General accuracy and stability metrics for putting a desired effect on a target must be considered when designing and developing autonomy applications. Current task metrics for the proposed application must be at the same level as or better than manned assets.
31. Multi-aircraft coordination (Option year): What coordination protocols (leader-follower vs. distributed), comms assumptions, and loss-of-comms behaviors are expected?
32. **A: Coordination and communication protocols are not yet defined but will be communicated at appropriate time for selected performers. Multi-aircraft coordination protocols should be proposed by the offeror and included as a part of the initial proposal.**
33. Test venues & schedule: What government-organized simulation exercises and flight demonstration windows are planned, and what range/airworthiness processes gate those events?
    A: Simulation and live flight demonstration schedule, location, and range airworthiness processes will be coordinated by the government team.
34. Safety cases: What safety artifacts are required (hazard analysis, FMEA/FTA, flight test cards, safety-of-flight release), and who is the airworthiness authority?
    A: Application specific safety artifacts will be generated by the performer post-award as required; the government team will review and approve artifacts to support FAA experimental airworthiness requirements and any ancillary safety assessments.
35. Ops approvals: Any required coordination with US Forest Service/state agencies for wildfire exercises, and what payload restrictions (buckets/tanks/hoist gear) apply?
    A: State agency coordination is expected but undefined at this time. Expect typical wildland firelighting payloads associated with bambi buckets and collapsible belly tanks. The government team will coordinate with state agencies post-award.
36. Cyber posture: Do you require Software Bill of Materials (SBOMs), static/dynamic code scans, Risk Management Framework artifacts, and container hardening for the mission app? What is the Authority to Operate (ATO)/ATO-Lite expectation for Phase II?
    A: Application specific cybersecurity software artifacts will be generated by the performer post-award as required; the government team will review and approve artifacts as required. The ATO will be handled by the government team, with supporting offeror artifacts as required for documentation.

37. Software deliverables form: Do you require containerized binaries, source code escrow, CI/CD pipelines, and developer docs/tutorials for government reuse?
    A: Application specific software artifacts will be generated by the performer post-award as required; the government team will review and approve artifacts to support government reuse as required.
    Source code and other IP-related items for government purpose use will be negotiated prior to award.
38. We have expertise with AFSIM and would like to know if there is an existing AFSIM simulation? Has ALIAS and Matrix been integrated or interfaced with AFSIM already? Are the other components listed (terrain, wind, etc.) already integrated in the AFSIM environment? Is GenHel integrated with AFSIM?
    A: Dynamics and simulation artifacts will be as needed, of sufficient fidelity, and produced by the test bed. Other artifacts such as air data sensors, radaltimeter, wind and humidity, will also be developed and utilized as necessary. ALIAS/Matrix and the GenHel will be integrated into the simulation stack.
39. The Phase I description references "existing modeling and simulation environments" the performer should provide. Are there any minimum requirements for the existing environments?
    A: Modeling and simulation environments should be as needed, of sufficient fidelity to validate simulation results in flight test and provided by the offeror as part of the initial proposal. Offeror may propose minimum modeling and simulation environment requirements as a part of the proposal package.
40. Is high fidelity microscale weather modeling that captures the impact of the fire part of an existing environment, and if not is adding that capability to the sim environment in scope for this effort?
    A: Consult AFSIM capabilities for existing application development environment capabilities. If desired, offerors may provide additional, high fidelity weather modeling capability as a part of the proposal package.
41. The solicitation also states "Later phases of app development will expand the simulation environment to include real-world data." Again, will these expansions be provided to the performers or should they be included in the scope of the proposed work tasks?
    A: Real world data will be provided by the government team.
42. Are small, unmanned platforms of interest as recon platforms, and if so are there particular platforms of interest?
    A: Heterogenous systems of systems are of interest. No, there are not particular platforms of interest. Platform specifics and requirements will be provided to the offeror on funding award.
43. The solicitation references manned/unmanned teaming. Are there specific manned platforms of interest?
    A: Reference SBIR proposal requirements for application development and integration on the S-76 and UH-60. Additional manned platforms or fixed-wing assets may be integrated at a later date at the discretion of the government team.
44. The existing ALIAS/MATRIX system appears capable of many of the desired single-vehicle autonomy behaviors, e.g., flying a planned route, conducting automated take-off, landing, slung-load operations, obstacles detection and avoidance, and hover operations. What are the key capability gaps in the current single-vehicle autonomy that need to be addressed? Is the interest primarily at the mission planning level, or are there deficiencies in lower-level capabilities like waypoint following, flight control in windy / turbulent environments, take-off, and landing?
    A: Offerors should include their proposed level of control and ideal autonmous tasking in the initial proposal package. Proposed autonomy applications will be implemented on top of the ALIAS/Matrix core. Autonomy for the UH-60 has been sufficiently developed, now the government team is primarily interested in bespoke behaviors in the area of mission

planning. There are no deficiencies in lower-level control, rather the focus of this SBIR is on higher-level firefighting tasks.

45. Can you clarify the focus areas? Is it perception, task management?
    A: Initial focus areas are water/retardant drops, cargo sling loads, medical evacuations, reconnaissance, and crew shuttles. Apps should have capabilities necessary to enable test aircraft to perform these complex tasks with minimal human intervention, such as search, localization, tracking, suppression, and assessment. Refer to F2T2EA military kill chain methodology for further clarification.
46. Is human-machine interface within scope?
    A: An HMI is/isn't a component of the proposal depending on the proposed app functionality. An HMI to interface with the A/C does already exist and the app will be expected to pass data on the back end. However, front-facing HMI apps have been developed utilizing the SDK with the ability to pass information on a tablet. The implementation is up to the proposer if their app would function better with a standalone HMI.
47. Sikorsky has been working with a company called Rain for over a year on fire suppression and management and has conducted multiple live demonstrations. Do you envision this SBIR work as complimenting the existing partnership between Sikorsky and Rain? Are you looking for a solution that accomplishes similar objectives as the Rain approach, but in a different way? Is it important for the small business to work with Rain?
    A: This award is seeking 1-2 proposers for autonomous aerial platform emergency services app development, with a specific initial focus in wildfire suppression. No performers in this space are currently under contract with DARPA.
48. Is there a software architecture (e.g., MOSA) that we should use to integrate our systems?
    A: This SBIR Topic is open to any and all software architectures.
49. Are there existing sensors on the helicopter we can use? If so, could you list them? These include both proprioceptive and exteroceptive sensors.
    A: Yes, initial sensing capabilities include LIDAR, EO/IR, etc. Other vehicle sensors such as air data sensors, radar altimeter, wind and humidity, will also be developed and utilized as necessary.
50. Are there requirements or limitations on any additional sensors, like size, weight, power, cost (SWaP-C)?
    A: There are no requirements or limitations for additional sensors. Any and all traditional sensing equipment and operations available off-the-rack or published on the UH-60 are of interest to the application development team.
51. What are the operational conditions of the OPV: such as altitude range, weather conditions, prevalence of other air traffic, restrictions to be aware of, etc?
    A: OPV can operate in the standard flight envelope of a UH-60. In fully autonomous mode, it can execute basic collision avoidance with more development in air traffic management to come in the near future. The demonstration vehicle currently operates under an FAA Experimental certification (X Ticket). Restrictions to the autonomous test bed will be relaxed as the program progresses.
52. What are the integration requirements for software with an existing autonomy / UI stack?
    A: Software integration requirements will be provided to offerer upon SBIR award.
    A UI/HMI is/isn't a component of the proposal depending on the proposed app functionality. A UI/HMI to interface with the A/C does already exist and the app will be expected to pass data on the back end. However, front-facing UI/HMI apps have been developed utilizing the SDK with the ability to pass information on a tablet. The implementation is up to the proposer if their app would function better with a standalone UI/HMI. Interface designs expectations are that they are to be designed to be usable in a high stress environment by non-technical personnel.

53. What are the Key performance metrics for Sim vs real flight?
    A: Performance metrics will be cemented upon final review of program test plan. The government expects no significant difference between sim performance and real flight, ie app should perform the same whether in sim or real flight.
54. Are there any references to the current state of the ALIAS/MATRIX autonomy stack?
    A: Reference information for the ALIAS/MATRIX autonomy stack will be provided to offerors upon SBIR award.
55. Expected obstacles for operation: Are tree canopies the only obstacles, or are there any other obstacles that are a priority?
    A: Offerors should anticipate multiple types of obstacles to avoid and design apps capable of avoiding mission representative obstacles. Any and all obstacle avoidance in the field of emergency services capability provided via autonomy app development are available for consideration and evaluation.
56. Is the desired autonomy technology stack meant to address one of the given scenarios or a more generic solution to address all?
    A: Apps may address one or multiple focus areas: water/retardant drops, cargo sling loads, medical evacuations, reconnaissance, and crew shuttles. Apps should have capabilities necessary to enable test aircraft to perform these complex tasks with minimal human intervention, such as search, localization, tracking, suppression, and assessment.
57. Are we restricted to using the mentioned aircraft (UH-60 /S-76), or can we incorporate supporting group 1 or 2 UAVs into the autonomy ecosystem?
    A: Reference SBIR proposal for performance demonstration using S-76 and UH-60 optionally piloted helicopters. Additional manned/unmanned platforms or fixed-wing assets may be integrated at a later date at the discretion of the government team.